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# *Ganoderma hoehnelianum* has priority over *G. shangsiense*, and *G. williamsianum* over *G. meijiangense*

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**Abstract** — Some type specimens of *Ganoderma* from tropical and subtropical Asia were studied. The results revealed that *Ganoderma hoehnelianum* and *G. williamsianum* are earlier names for two species of *Ganoderma* originally described from China, *G. shangsiense* and *G. meijiangense*, respectively.

**Key words** —*Elfvingia*, *Ganodermataceae*, *Polyporales*, taxonomy

## Introduction

In China, Zhao & Zhang (2000) considered the genus *Ganoderma* P. Karst. to contain three subgenera and discriminated subgenus *Elfvingia* (P. Karst.) Imazeki from the other two by its non-laccate upper pilear surface, thick cuticle of trichodermic, anamixodermic, or plecodermic composition and uniformly brown, dark brown, or chestnut brown context. In the same paper they recorded twenty species of subgenus *Elfvingia* from this region and ten of them were new to science (Zhao et al. 1984, 1986; Zhao & Zhang 1986, 1987a,b; Zhao 1988a,b). After studying the type specimens of these "new species," we found that *Ganoderma meijiangense* and *G. shangsiense* are synonyms of *G. williamsianum* and *G. hoehnelianum* respectively. Descriptions for these two species were based solely on Chinese collections.

Methods for morphological studies mainly followed those previously described by Wang & Wu (2007). Sections for cuticular observations were

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taken from the pileus, and color of cuticular hyphae was recorded when treated with Melzer's reagent. Basidiospores were mounted in 5% KOH and only spores with a collapsed apex were measured.

## Taxonomy

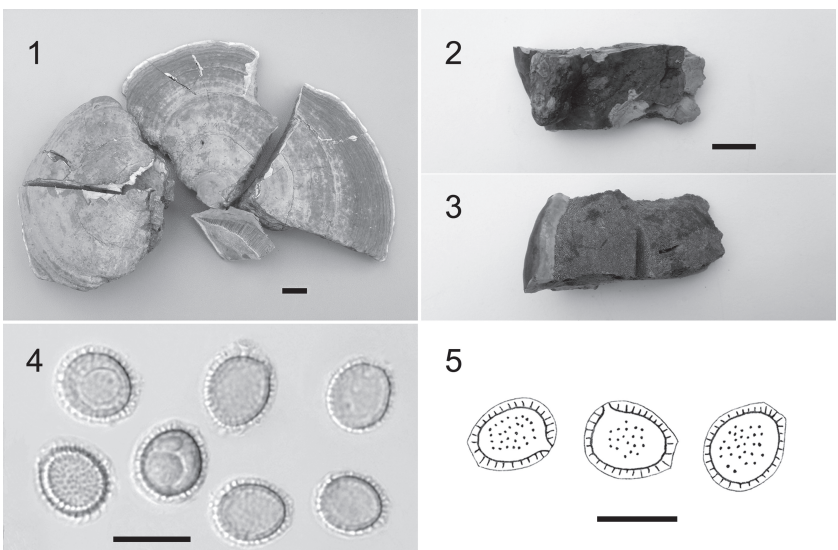
***Ganoderma hoehnelianum*** Bres., Ann. Mycol. 10(5): 502 (1912). Figs. 1–5

= *Ganoderma shangsiense* J.D. Zhao, Acta Mycol. Sin. 7(1): 17 (1988).

A full description of Chinese *G. hoehnelianum* was given by Wang et al. (2005; as *G. shangsiense*). The description of *G. shangsiense* was based on its holotype (HMAS 29739) and five other Chinese collections (HMAS 29740, 29741, 29742, 73477, 130043).

Specimens examined—**CHINA. Guangxi:** Shangsi county, on rotten wood, 5 Nov. 1958, Z.-C. Liang *1652* (HMAS 29741). **Hainan:** Diaoluoshan, on rotten wood, 29 Sep. 1958, J.-H. Yu *325* (HMAS 29739, **Holotype** of *G. shangsiense*); Diaoluoshan, on dead wood, 25 Sep. 1958, J.-H. Yu *147* (HMAS 29740); Diaoluoshan, on living tree, 4 Oct. 1958, J.-H. Yu *350* (HMAS 29742); Diaoluoshan, on rotten wood of broad-leaved tree, 11 Apr. 1993, J.-P. Lai *1799* (HMAS 73477); Diaoluoshan, on dead wood of *Quercus patelliformis*, 13 Dec. 2003, D.-M. Wang *28* (HMAS 130043). **INDONESIA. Java:** Tjibodas, v. Hoehnel (BPI 236008, **Isotype** of *G. hoehnelianum*).

Distribution—Indonesia (Bresadola 1912, Ryvarden 1988), China (this study).




Figs 1–5. *Ganoderma hoehnelianum* (Figs 1, 4: HMAS 29739; Figs 2, 3, 5: BPI 236008). Fig 1. Basidiocarps; Fig 2. Upper surface of the basidiocarp fragment; Fig 3. Pore surface of the basidiocarp fragment; Fig 4. Basidiospores; Fig 5. Basidiospores. Bars = 1 cm in Figs 1 & 2; = 10 μm in Figs 4 & 5.

Notes—Only a small pilear fragment remains from the isotype of *G. hoehnelianum* (BPI 236008). However, this portion was enough to recognize the species. The basidiocarp has a dull yellowish brown to blackish brown upper pilear surface; a vividly yellow pore surface, becoming purplish-brown on bruising; duplex context with yellow or bright yellow approaching the cuticle and yellowish brown to brown near the tube layer, with two black crustose layers; pale brown to brown tubes; broadly ovoid to subglobose basidiospores with thick echinulae and only a slightly truncate apex (11.0–12.0 × 8.5–9.5 μm); an anamixodermic cuticle composed of pale yellow, interwoven hyphae. The combined features of context color, basidiospore characteristics, and cuticular composition are the most reliable criteria in recognizing *G. hoehnelianum*. The Chinese collections of *G. shangsiense* bear the same characteristics (Wang et al. 2005).

***Ganoderma williamsianum*** Murrill, Bull. Torrey Bot. Club 34: 478 (1907). Figs. 6–12

≡ *Elfvingia williamsiana* (Murrill) Imazeki, Bull. Gov. Forest Exp. St. Tokyo 57: 106 (1952).

= *Ganoderma meijiangense* J.D. Zhao, Acta Mycol. Sin. 7(1): 16 (1988).

Basidioma annual to perennial, mostly sessile, rarely with a stipe-like base, lightweight, corky. Pileus 3.5–4.7 × 6.5–10.0 cm, reniform, dimidiate, ungulate or irregularly shaped due to imbrication; upper surface reddish brown to purplish black or black, partly strongly laccate, finely but distinctly and concentrically sulcate, slightly to distinctly radially rugose; margin rounded, incurved, concolorous with the pileus. Pore surface dark yellow or bright yellow; tubes up to 1.9 cm long in total, brown or dark brown; pores circular, 5/mm, 100–200 μm diam., dissepiments 45–90(–120) μm thick. Context up to 1.5 cm thick, yellowish brown to reddish brown, with black crustose layers, corky; generative hyphae 3.0–4.5 μm diam., colorless, thin-walled; skeleto-ligative hyphae 5.5–8.0 μm diam., yellowish brown to reddish brown in KOH, arboriform with short sinuous branches. Basidiospores (10.5–)11.5–13.2 (–14.5) × (7.5–)8.5–9.5(–11.0) μm (with myxosporium), (9.2–)10.0–11.5 (–12.0) × (6.2–)7.5–8.0(–9.5) μm (without myxosporium), ellipsoid, mostly truncate at apex, brown, with a dark brown eusporium bearing very thick echinulae and longitudinally ridged ornamentations. Cutis anamixodermic, composed of yellowish brown, dextrinoid, thick-walled hyphae usually with numerous irregular protuberances, and colorless or pale yellow, thin-walled hyphae arising from the yellowish brown hyphae, easily broken and peeled off.

Specimens examined—**CHINA. Hainan:** Hainan Botanical Garden, alt. 300 m, on rotten wood, 31 Oct. 1958, J.-H. Yu & J.-C. Xing *535* (HMAS 27076); Diaoluoshan, on fallen wood, 6 Nov. 1960, J.-H. Yu & R. Liu *2807* (HMAS 31826, **Holotype** of *G. meijiangense*); Diaoluoshan, on rotten wood, 26 Sep. 1958, R.-Y. Zheng et al. *212* (HMAS 26159); Jianfengling, on dead standing tree, 5 May 1960, J.-H. Yu & R. Liu *1262* (HMAS

30879). **Yunnan:** Meijiang county, on rotten wood, 19 Apr. 1957, Bailiangshiji (HMAS 29751). **PHILIPPINES. Luzon:** Lamao River, Jan. 1904, R.S. Williams (BPI 236684, **Isotype** of *G. williamsianum*).

Distribution—Phillipines (Murrill 1907, Steyaert 1972), Indonesia (Imazeki 1952, Steyaert 1972), Malaysia (Steyaert 1972), China (this study).

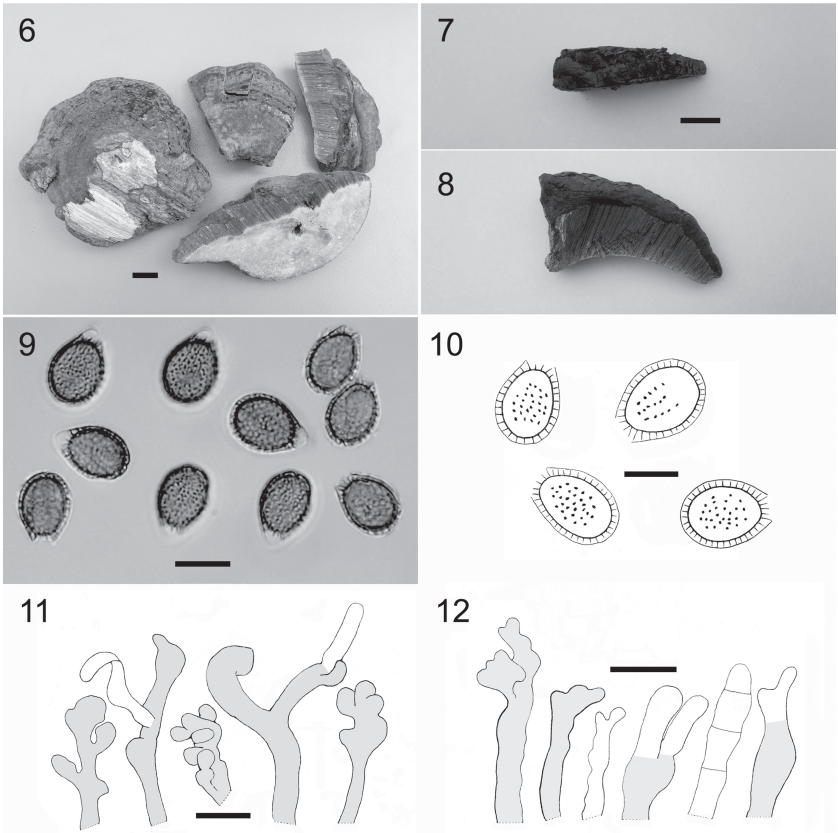
Notes—The isotype of *G. williamsianum* (BPI 236684) comprises only a slice of a basidiocarp. Based on this material, the main features of *G. williamsianum* can be summarized as follows: strongly laccate, reddish brown pileus; vividly yellow pore surface; reddish brown context becoming yellowish brown near the cuticle, with two black crustose layers; skeleto-ligative hyphae with consistently short branches; pale brown tubes; ellipsoid basidiospores with rather thick echinulae and longitudinally ridged ornamentations (13.5–16.0 × 9.0–10.5 μm); cuticle composed of thin-walled, interwoven hyphae usually with apical protuberances, colorless or pale yellow (inamyloid) or bluish black (amyloid).

Steyaert (1972) emphasized peculiarities of two characters in *Ganoderma williamsianum*. First, the cutis is composed of "hyaline" hyphae only; secondly, hyphae grow in a wavy or zigzag manner. The first feature is merely one transitional form from anamixoderm to characoderm (Corner 1983). The second feature illustrated in Steyaert (1972) and Corner (1983) is from short sinuous branches at the ends of the skeletal hyphal stalk. In addition, *G. williamsianum* is also easily recognized by having a yellow pore surface, dark brown context, and large basidiospores with striped ornamentation.

*Ganoderma williamsianum* superficially resembles members of the laccate *Ganoderma* group by its macromorphology. Aoshima (1971) misinterpreted the cuticle of this species as a palisadoderm. In reality, *G. williamsianum* has an anamixodermic cuticle and is a member of *Elfvingia* group (Imazeki 1952, Moncalvo & Ryvarden 1997).

Corner (1983) considered that *G. williamsianum* needed to be compared with *G. brownii* (Murrill) Gilb., an American species collected from California. *Ganoderma brownii* is very similar to *G. williamsianum* in color of pore surface (Lowe & Gilbertson 1961, Gilbertson & Ryvarden 1986). However, *G. brownii* can be easily distinguished from *G. williamsianum* by having a dull pileus with a hard, not easily broken crust (Lowe & Gilbertson 1961) formed by hyphae arranged in a trichoderm (Steyaert 1972, Gottlieb & Wright 1999), skeletal hyphae with occasional branching (Gilbertson & Ryvarden 1986), and smaller basidiospores (9–12 × 7–9 μm in Lowe & Gilbertson (1961), 9.5–10.6–12 × 6.5–7.6–8 μm in Steyaert (1972), 11–12 × 7–8 μm in Gilbertson & Ryvarden (1986), (9–)10–11 × 6–7(–8) μm in Gottlieb & Wright (1999)).

Zhao (1988a) stated that *G. williamsianum* is similar to *G. meijiangense* but distinguished from the latter by having dark brown context without any black crustose layer and a distinct cuticular composition. However, these




Figs 6–12. *Ganoderma williamsianum* (Figs 6, 9, 11: HMAS 31826; Figs 7, 8, 10, 12: BPI 236684). Fig 6. Basidiocarps; Fig 7. Upper surface of the basidiocarp fragment; Fig 8. Vertical section of the basidiocarp fragment; Fig 9. Basidiospores; Fig 10. Basidiospores; Fig 11. Cutis hyphae (Pale parts indicating colorless or pale yellow, thin-walled hyphae; Dark parts indicating yellowish brown, thick-walled hyphae); Fig 12. Cutis hyphae (Pale parts indicating colorless or pale yellow, thin-walled hyphae; Dark parts indicating bluish black hyphae). Bars = 1 cm in Figs 6 & 7; = 10 µm in Figs 9–12.

characters used for discrimination by Zhao (1988a) have not been supported in this study. The isotype of *G. williamsianum* BPI 236684 has dark context with black crustose layers, while the holotype of *G. meijiangense* HMAS 31826 has a cuticular composition with colorless or pale yellow, thin-walled hyphal ends. Further, HMAS 31826 has the skeleto-ligative hyphae which are typical for *G. williamsianum*. The Chinese collections of *G. meijiangense* cited above agree well with *G. williamsianum* in morphology except for having slightly smaller basidiospores.

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